AD-A066 689 TEXAS UNIV AT AUSTIN DEFENSE RESEARCH LAB F/G 17/1
BIANNUAL PROGRESS REPORT NUMBER 5 FOR CONTRACT NOBSR-93124, 1 J--ETC(U)
OCT 67

UNCLASSIFIED NL

END
DATE FILMED
5-79
DDC

DEFENSE RESEARCH LABORATORY

THE UNIVERSITY OF TEXAS

AUSTIN, TEXAS 78712

UNCLASSIFIED
~~CONFIDENTIAL~~

LEVEL II

(1)

AD A066689

DDC FILE COPY

(6) BIANNUAL PROGRESS REPORT ~~NO.~~ 5 for (Number)

CONTRACT NObsr-93124, (C)

1 January through 30 June 1967

(11) 4 October ~~1967~~

(12) 25 p.

Copy No. 1.

Task 8503, Project Serial Number SF0010316 (U)
Task 10910, Project Serial Number SS041000 (U)
Task 8212, Project Serial Number SF0010316 (U)
Task 8513, Project Serial Number SF0010316 (U)

(16) F00103, SS0419

(17) SF0010316, SS041000

Resulting from research done under

Naval Ship Systems Command

GROUP-4
Downgraded at 3 year intervals;
declassify after 12 years

107500

DEFENSE RESEARCH LABORATORY
THE UNIVERSITY OF TEXAS AT AUSTIN
AUSTIN, TEXAS 78712

UNCLASSIFIED
~~CONFIDENTIAL~~

671102-0304

UNCLASSIFIED

Biannual Progress Report No. 5 for Contract NObsr-93124 (U)
for the period 1 January 1967 through 30 June 1967
Project Serial No. SS041000, Task 10910
Project Serial Number SF0010316, Tasks 8212, 8503, and 8513

Task 8503, Project Serial Number SF0010316
Visual and Auditory Signal Recognition

AN/SQS-23 SME Playback Program
(L. A. Jeffress)

Under this project, the Signal Recognition Group has supervised the selection and giving of a set of paper-and-pencil tests to the group of sonar operators who participated in the SME Playback Program. The tests were administered and scored, and have been correlated with four measures of sonar performance. The four measures are the percentage of detection after the tenth ping for four different false-alarm rates, 5%, 10%, 30%, and 40%. The sonar measures correlated fairly closely, and it is planned to employ the detection score for the 10% false-alarm rate to determine the regression weights in a multiple regression program. These weights will then be employed to predict performance on the other three sonar tests, to determine the degree of "shrinkage" in the predictions.

In addition to this participation, Dr. Lloyd Jeffress is serving on the Exploratory Development Display Panel for Naval Ship Systems Command 1622. The panel met at TRACOR on 8 June 1967 to discuss organizational plans and to inspect TRACOR's color display project.

Programming-Recording Equipment

The programming-recording equipment described in earlier reports has been in operation for several months and is proving very satisfactory. Some trouble has been encountered with the relays that operate the IBM punch and these are gradually being replaced by high-voltage transistors as they become available. The transistors have only recently been available in production, and delivery is still slow. Those that have already

been installed to replace some of the relays are proving reliable and trouble free. The remaining relays will be replaced as soon as the remaining transistors on order have arrived.

The equipment is very flexible permitting accurate recording of the stimulus employed and the responses from four subjects at a time. Not only conventional detection data, but serial order effects and multiple observer responses can be examined at any time during the experiments as well as after its termination. A detailed description of the equipment is in preparation as a DRL Acoustical Report.

Shape of the Critical Band of the Ear

A study of the width and shape of the critical band of the ear is nearing completion. The shape of the ear's filter is being determined by approaching the frequency of the signal employed (500 Hz) from each side through the use of a combination of low-pass and high-pass filters. Results so far indicate that the filter is unsymmetrical in shape, differs in bandwidth from one subject to another, and also differs in effective width as a function of the level of the masking noise being employed. It is planned to publish the results of the study and to issue reprints of the article as a DRL Acoustical Report.

Experiments with an Electrical Model of the Ear

One study of the behavior of an electrical model of the monaural hearing apparatus has been completed and published in the Journal of the Acoustical Society of America 41, 480-488, 1967, and issued as DRL Acoustical Report No. 286. The article, by Lloyd A. Jeffress, is entitled "Stimulus-Oriented Approach to Detection Re-Examined."

The model has been employed along with three human subjects in a two-alternative, forced-choice experiment, and proves to be able to predict one another's. Because of its close resemblance to the behavior of

human subjects, it is being studied further to discover what choice of parameters most closely resemble human performance.

The analogical features of the model are in the process of being simulated digitally by means of the CDC 3200 computer with the hope that the determination of the effects of various changes of parameters can be determined more expeditiously than can be done with the analogical model.

A Binaural Electrical Model

Because the monaural electrical model has proved so fruitful in understanding many of the basic phenomena of signal detection by human observers, a binaural model has been constructed which, in addition to the usual phenomena of monaural detection, shows the great enhancement of performance that occurs when the noise and the signal differ in their interaural phase relationships. The model is being employed along with three human observers in a two-alternative, forced-choice experiment.

Visual Detection

A study of the detection of a brief visual target (small spot of light) under various conditions of exposure to light is nearing completion. The study will be used as a doctoral dissertation, published, and issued as a DRL Acoustical Report.

Abstracts of Papers

The abstracts of two papers resulting from work under the contract and presented at the April 1967 meeting of the Acoustical Society of America are appended.

APPENDIX

ABSTRACT

ACOUSTICAL SOCIETY OF AMERICA, APRIL 1967

Electrical Model for Binaural Detection. Lloyd A. Jeffress and Audley D. Gaston, Jr., Department of Psychology and Defense Research Laboratory, The University of Texas, Austin, Texas 78712. An electrical model that takes a running average of interaural time differences yields results similar to human performance under several binaural conditions--NOSπ, NπSO, and NOSm--with continuous noise and gated signal. It shows a response to signal duration similar to that given by people. Previous models, such as the theta model and the E-C model, have no provision for handling the case of the continuous noise and gated signal and leave the effect of signal duration under these conditions unaccounted for. The device achieves its measurement of time difference by amplifying and clipping the inputs from the two channels, subtracting one from the other, and discarding differences of one sign while averaging those of the other. The voltage being averaged can be expressed by the equation:

$E = E_i \frac{e^{t/RC} - 1}{e^{T/RC} - 1}$, where $\underline{t}$ is the time that, say, the left ear leads the right, T is the period of the center frequency of the narrow-band noise, and E_i is the magnitude of the rectangular input voltage. [Work supported by a contract with the Naval Ship Systems Command, Department of the Navy, and through a grant from the National Aeronautics and Space Administration.]

ABSTRACT

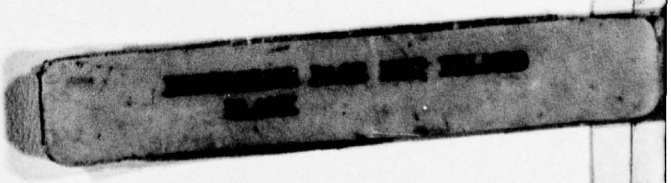
ACOUSTICAL SOCIETY OF AMERICA, APRIL 1967

ROC Curves for Multiple Signal Levels in a Detection Task. Ann Tucker, Rand B. Evans (non-member), and Lloyd A. Jeffress, Department of Psychology and Defense Research Laboratory, The University of Texas, Austin, Texas 78712. Seven signal levels were presented to four observers in a pseudorandom fashion. A 500 Hz tone was used, and the signal duration was maintained at 100 msec with a rise-decay time of 10 msec. Wide band (100-3000 Hz) continuous noise was used as the masker. The listening interval was indicated by a light, and observers were instructed to classify or rate the loudness of the masked signal, by using one of 10 ordered push buttons. On some trials noise alone was present; on the remaining trials $(2E/N_o)^{\frac{1}{2}}$ ranged from 2.0-5.0. Receiver operating characteristics were plotted for each signal level, and a remarkably small number of trials was needed to yield satisfactory curves. The multiple-level rating procedure yields smooth curves for seven signal levels in about the same time previously needed for only one level. The observer's task, to rate the loudness of the stimulus, appeared to be simpler than that of earlier studies, in which he was asked to rate his "certainty" that a signal was present. [Work supported by a contract with the Naval Ship Systems Command, Department of the Navy, and through a grant from the National Aeronautics and Space Administration.]

Task 10910, Project Serial Number SS041000

AN/SQS-26 Classification Package
(K. W. Harvel)

During this report period Defense Research Laboratory Acoustical Report Number 279 (DRL-A-279), entitled "Technical Tests of the AN/SQS-26 Classification Package" (U) by K. W. Harvel was issued. This will terminate effort on this project.



Task 8212, Project Serial Number SF0010316

A. TRESI Classification Equipment
(K. J. Diercks and L. D. Hampton)

(U) Preparation of the final report on the technical evaluation of the TRESI classification equipment progressed satisfactorily, but slowly, during the report period. Additional analyses and evaluations of system operation and performance were carried out and incorporated into the report. Preparation of the report will be completed in August; a November distribution date is anticipated.

B. ASW Classification Panel
(S. P. Pitt)

(U) During the first six months of 1967, the need for reporting the status of work in ASW active sonar classification to interested Naval and industrial personnel was considered by the Panel and sponsors (NavShips, Code 00V1C). At that time, the panel members were engaged in attempting to outline a classification program for future work, by establishing areas of need and relative priorities of the different areas. This classification program was needed, it was felt, in order to allow as intelligent choices as possible in funding work in the area, especially for the upcoming fiscal year. The problem of providing some sort of guidance to prospective contractors in order to produce the most pertinent proposals possible arose naturally. Obvious problems arise in this area, since unsolicited proposals are highly desirable for work in exploratory development.

(U) The consideration of these two needs, the reporting of the status of work and the areas of need for future work, led to the consideration of fulfilling both by means of a special symposium on active sonar classification. During a meeting in Washington on 4-6 January, it was decided to attempt to establish such a symposium later in the year.

Specific tasks in the production of the symposium were assigned to the various organizations (DRL, NEL, and NavShips); and a date of 3-5 October was eventually set.

(U) With the occurrence of a symposium, it was decided to delay interviews with specific investigators until after it was over, as an outline of specific program goals would be presented. Thus, only a minimum of proposals were considered. Autonetics was the only group visited by Panel members Pitt and Harvel, on 26 May, following a proposal submitted by them. Comments on their presentation were forwarded to NavShips during June.

(U) Following the establishment of a firm time and schedule for the symposium, all panel members became engaged in the preparation of papers. These were to be submitted in final form to DRL, for pre-symposium publication, by 15 August. Most of the time related to the Panel during the remaining months was devoted to this task.

(U) During the meeting in January, a final version of the reply to the request for information by the New Submarine Sonar Office was agreed upon. This was forwarded to that office in the form of a NavShips letter.

(U) In February, Dr. G. S. Innis, then a Panel Member from DRL, announced his intentions to terminate from DRL and thereby from the Panel. Mr. K. W. Harvel was selected to replace him on the Panel.

(U) One other Panel meeting was held at NEL on 24 May. At this time, DRL's version of an overall program was presented and commented upon. The comments were incorporated into modifications, and the program was submitted to NavShips, Code 00V1C.

C. Operations Analysis Section
(R. K. Goodnow)

(U) 1. Resume

During this report period the Operations Analysis Section completed the following tasks:

(U) a. Preliminary analysis of the results of the Operator Classification Performance Test Study was completed, and a report issued. A significant amount of further analysis of these test results has been performed, and work is underway toward achieving a method for multiple correlations of test results with other measures of operator skill.

(U) b. An analysis of the IBM Sonar Classification Display System (SCDS) was carried out during the months of February and March. A small but important portion of this work remains to be completed later this year.

(U) c. The installation of a PME (Performance Monitor Equipment) in the Playback Facility, which replaced the second SME, and rewiring of the Playback Facility was essentially completed.

(C) 2. During the report period the following trips were made by section personnel:

a. Mr. R. K. Goodnow traveled to the Fleet ASW School (FASWS) in San Diego, California during the period 15 through 27 January 1967. He attended a Civilian Orientation Course in ASW, which is periodically given by the Fleet ASW School for civilian contractors. This course gives an overview of the total ASW picture that would be impossible to achieve in any other way. Subjects ranging from individual weapon capabilities to task group tactics were discussed and explained by instructors who seemed expert in their fields. It is felt that

attendance at this course would be valuable for any scientist engaged in work in any part of ASW, enabling him to relate his work to the whole field.

(U) During the week of 23 January 1967, Dr. L. D. Hampton and Mr. R. K. Goodnow of DRL, and Mr. George Miller of Naval Ship Systems Command, met with CAPT Buaas, USN, Commanding Officer, FASWS, and reached agreement that liaison between FASWS and DRL should be formally established. Mr. Goodnow spent the rest of that week conferring with Mr. Paul V. Asa-Dorian, and LCDR Ray Evans, of the Sonar Technology and Recording (STAR) Group at FASWS

(C) b. From 29 January through 1 February 1967, Mr. Goodnow traveled to Washington, D. C. where he attended the Tenth Annual Minefield Conference, presenting a paper entitled "A Small Radio Controlled Catamaran for use in Mine Neutralization," by R. K. Goodnow and L. A. Jeffress. This paper will appear in the Proceedings of the Tenth Annual Minefield Conference. It covered work done by Mr. Goodnow during the period 1964-65.

(C) c. From 5 through 9 June, Mr. R. K. Goodnow traveled to FASWS, San Diego, California to conduct testing on the sonar operators who were used as subjects for the Operator Classification Performance Test Study. This testing was carried out for a program arranged by Mr. James Jenkins of Naval Ship Systems Command, and was supervised by Dr. L. A. Jeffress of DRL. Dr. Jeffress will issue a report on the results of this testing.

(C) During this trip, time was also spent with Messrs. R. L. McFarland and H. R. Eady, U. S. Navy Electronics Laboratory (NEL) (now Naval Underseas Warfare Center-San Diego Division) concerning the Classification Symposium. Mr. Goodnow also met with Messrs. Pickering, Abrams, and Aiken of Naval Personnel Research Activity, to discuss DRL's work on the Operator Classification Performance Test and NPRA's work on RDT clue structures. Interest was expressed by both parties in each other's work, and tentative arrangements were made for further exchange of information.

3. Operator Classification Performance Test Study

(U) Defense Research Laboratory Acoustical Report Number DRL-A-281, entitled "A Study of ASW Sonar Operator Performance on a Realistic Classification Task: The Operator Classification Performance Test, Vol. I, (U) Part 1: The DRL AN/SQS-23--SME Playback Facility (U), Part 2: Test Construction and Preliminary Results (U)," by R. K. Goodnow, was issued on 16 June 1967. This report covers only the preliminary analysis of the results of the study, containing the individual operator ROC curves of performance on the test, and summary ROC curves combining several groups of operators. Further analysis is underway, and it is expected that this exhaustive analysis will be completed sometime during the fall, and Vol. II of the report will be issued in late 1967 or early 1968.

4. The IBM Sonar Classification Display System Analysis

(C) A thorough analysis and measurement program was carried out on the SCDS during February and March. This included a checkout of the technical specifications of the SCDS, which was somewhat short of a technical evaluation but more than a cursory examination. Measurements were made of the linearity and dynamic range of the quantization system of the SCDS. Measurements were made of the responsiveness and accuracy of the range rate solution capability, and between 500 and 600 pictures were taken of the SCDS display of FM correlator outputs taken from sonar data; also of sonar data taken from the SME playback of normal SQS-23 pinging. The Operator Classification Performance Test was presented to two subjects using the SCDS as an auxiliary display, as well as a DRL display that utilized the SCDS outputs.

(U) Recommendations were made to IBM at the end of March, and it was requested that the SCDS be left at DRL for a short period of further testing later in the year. It is expected that this testing will be carried out early in the second half of 1967, and that a DRL

Technical Memorandum on this analysis will be released very shortly thereafter.

5. Installation of the PME, and Rewiring of the Playback Facility

(U) When it was decided to remove the second SME from the Playback Facility, replacing it with a PME, it was also decided to make the SME/PME installation a double master system. With this system, dubs could be made in either direction; from SME to PME, or from PME to SME. It was thought unlikely that there would be any necessity for making PME to SME dubs, but when a second PME is substituted for the SME, this capability will be very useful. The double master system required the installation of the second junction box, a master playback switch, and interlocking so that when either machine was playing back into the sonar system the other machine could only be put into "Record" or "Off."

(U) During the course of the installation, three new technicians were hired, and trained on the Playback Facility. Two of these were hired to complete the compliment of personnel for the Playback Facility, and the third was hired to replace Mr. L. J. Schoellmen, who left DRL in May. The training of these technicians lengthened the installation period somewhat.

(U) It is expected that the calibration of the playback system, including the PME, will be completed early in the second half of 1967, and that very soon thereafter the dubbing of tapes from SME to PME will be initiated. It is planned that as soon as possible the SME will be phased out, after all useful tapes have been dubbed onto PME. Sometime in the near future, hopefully, the SME will be replaced with a second PME, thus completing the Playback Facility.

6. Work List for the Second Half of CY 1967

(U) During the second half of CY 1967, it is planned that the following work will be completed, not necessarily in the order given:

a. The last part of the SCDS analysis will be completed, and a DRL Technical Memorandum on the analysis of the SCDS will be issued.

b. SME tapes will be dubbed to the PME, in order to phase the SME out of the Playback Facility. All data tapes presently in SME format will be dubbed to the PME format.

c. A field trip will be made to take more basic data, both for sonar and for ASPECT. It is hoped that ASPECT data taken on this trip can be used in generating a useful ASPECT test.

d. A trip will be made to FASWS to measure TRAM parameters and to assure compatability of the DRL and FASWS Playback Facilities.

e. A paper will be presented at the Active Sonar Classification Symposium.

f. The Playback Facility will be moved to the new DRL building, and all equipment will be transferred from the van into a large laboratory room. The primary reason for this move is the lack of space in the van.

g. Technical Memoranda will be written on the SCDS, on the A-Scan, on PME installation, and on SME-PME dubbing. Some of these will be issued as DRL Technical Memoranda. Vol. II of the OCPT report will be written and issued.

II. Task 8513, Project Serial Number SF0010316

A. Echo Recognition
(K. J. Diercks)

(U) The U. S. Navy Electronics Laboratory (NEL) 1/16 scale model of the submarine USS PERMIT (SSN-594) and the variable range surface rotator were both damaged as a result of severe weather at the Lake Travis Test Station (LTTS) during the last reporting period (July through December 1966). To avoid the effects of bad weather it was decided to construct an underwater rotator to be positioned at a fixed distance from the LTTS; the model would be "floated" above the rotator at an appropriate depth. Also, the finely scaled nose section of the model, which was partially damaged, would be replaced by a contoured nose section and a new suspension harness. Design and fabrication work on both the rotator and the contoured section was begun late in the last reporting period.

(U) Construction of the rotator was completed in late February. In early March the first attempt to position the rotator in Lake Travis was made. Instability of the rotator on the water surface caused the rotator-platform to overturn. In righting it, the rotator shaft was bent. This was repaired on site and the rotator was lowered to depth. However, as a consequence of dissatisfaction with stability and anchoring, plus misgivings about the condition of the shaft the rotator was raised; a new stronger shaft was made, stability problems were corrected (it was thought) and anchoring was improved.

(U) These modifications were completed in April, but reworking the rotator housing caused leaking to occur and this was not corrected until late May. Because of progressive lowering of the water level in Lake Travis, which resulted in an appreciable shortening of the

distance from the LTTS barges to the site of the rotator, the anchors were replaced at an approximate 400 ft test range. The second attempt to position the rotator at depth was made during the week of 1 June. The rotator was successfully pulled down to a depth of 55 ft where it overturned because of instability.

(U) The rotator was again raised and the platform modified to correct the instability. Leaking in the rotator housing was again observed; the locus was identified as the aluminum welds used to form the housing. A compound for sealing the weld joints was ordered in late June with delivery promised for mid-July. Additional buoyancy will be added to the platform to improve underwater stability. Flotation will be added to the electrical cables to minimize cable stretch. It is expected that a third and hopefully last, attempt to position the rotator can be made during late July.

(U) Work on the surface rotator barge, which was damaged during the fall months, was resumed during June. The rotator proper had been rebuilt by the beginning of this reporting period. Work on the capstan-drive barge-positioning system had been discontinued to permit construction of the underwater rotator. The capstan-drive was completed late in June; depending upon availability of engineering services the system will be installed on the rotator barge during July or August. Both the surface and underwater rotators will be used when operational. However, the surface rotator will see only limited use during the fall and winter months because of dependence upon weather conditions at Lake Travis.

(U) Patterns for casting the contoured section of the 1/22 scale model of the USS SKIPJACK (SSN-585) were received from Ordnance Research Laboratory (ORL), Pennsylvania State University, during the last reporting period. Requests for bids for fabricating missing patterns and for casting the sections were issued in

December. Bids were received in January. New casting patterns were completed in March and all patterns were sent to Dee Brass Foundry, Houston, Texas, for casting the model sections. Three sets of castings were ordered: one to construct a static model, one to implement a programmed self-propelled model, and a spare set.

(U) One set of castings was received in April; no descriptive information was included. In late May DRL was informed by Dee Brass Foundry that the set was for inspection only and was to be returned to them for additional treatment and testing. This set was returned in June.

(U) Design work on the self-propelled version of the SKIPJACK model has been hampered by lack of information on hydrodynamic characteristics, and screw specifications and performance. Information about the first was requested from the Ordnance Research Laboratory; information on the screw was requested from David Taylor Model Basin (now Naval Ship Research and Development Center, Carderock, Maryland). No reply to either request has been received.

(C) Instrumentation for an experimental study of STARLITE was begun in January. STARLITE is a theory of Space-Time Acoustic Recognition of Line Target Echoes, developed by Dr. F. Wiekhorst at the SACLANT ASW Research Centre, La Spezia, Italy. (Dr. Wiekhorst is now at the Naval Ship Research and Development Center, Carderock, Maryland.) The theory states that for a line target an aspect-dependent nondimensional frequency function exists. The scattered field of a target can be sampled by two spatially separated hydrophones and the outputs of the hydrophones cross-correlated. The existence of a correlation peak implies the line target. The correlation function can also be used to obtain the target's aspect and its turning rate.

(C) Because STARLITE bears upon the DRL classification program, a model study to investigate STARLITE parameters was undertaken at the Echo Studies facility at the LTTS. An acoustic system satisfying the conditions of the STARLITE theory was instrumented, and a solid steel cylinder 50 cm long by 3 cm o.d. was machined for use as a target. Data were obtained for three pulse lengths with time-bandwidth products of 144, 162, and 180, and for target aspect angles from 14 deg to 34 deg. Correlation functions were computed for these data, but no theoretical-experimental agreement was observed.

(C) A second target consisting of a line of five steel spheres, 2.5 cm o.d., equally spaced along an 0.6 cm o.d. steel rod was constructed in March. Data were obtained for this target, and for the cylinder described, for target aspect angles from 10 deg to 85 deg in 5 deg increments. Data were processed by envelope detecting the analog waveforms and computing cross-correlation functions. Correlation delay times obtained from the five-ball line were in agreement with predicted values obtained at aspect angles that did not satisfy theoretical requirements; i.e., 40 deg to 85 deg. No agreement was obtained for smaller aspect angles. Correlation delay times obtained from the data of the solid steel cylinder did not agree with predicted values at any aspect angle; no systematic variation as a function of target aspect was observed.

(U) Two new line targets--a 2 m long line of discrete cylinderical scatterers and a 2 m long cylinder--were constructed for use with the underwater rotator at a longer test range. However, the above described problems with the rotator have precluded their use to date.

(U) In early June, Dr. Wiekhorst and Mr. Ed Hug, U. S. Naval Ordnance Laboratory, White Oak, visited DRL for discussions of the STARLITE program. It was concluded that the targets used for the

DRL measurements were the probable cause of the observed discrepancies and should be replaced with similar targets constructed of a pressure-release material to avoid the complications of elastic scattering. Also, a larger thickness-to-length ratio should be employed. Therefore, the five-ball line of steel spheres was replaced with a five-ball line of styrofoam spheres, 5 cm o.d.

(U) Dr. Wiekhorst suggested using a more complicated target configuration to obtain more complex echo waveforms. A styrofoam cylinder with randomly spaced annular grooves machined into the surface was fabricated. Data were obtained on both the five-ball line and the random line using both long FM up and short cw pulses. Processing of these data will not be completed until late July or early August. Short cw pulse data will be processed in the frequency domain.

(U) The analysis of the spectral characteristics of the Rotating Directed- and Steered Directed-sonar transmission modes (RDT and SDT, respectively), begun during the last reporting period, was continued during the present reporting period. Fourier transforms of RDT, SDT, and searchlight transmission pulses were derived early in the period. The spectral characteristics of SDT and searchlight pulses could be determined from an examination of the transforms. A band-limited spectrum for an RDT pulse was computed using the DRL CDC 3200 computer.

(U) Analytic solutions for the pulse forms and their spectra for a plane array transducer and a Steered Directed Transmission were derived; the solutions indicated that the two transmissions differed. The equations were programmed and time-pressure and time-frequency plots were obtained. Band-limiting of the results was again effected by computer overflow. Solutions for the pulse forms and spectra for a rotating plane array were also derived, but no computations were carried out.

(U) RDT, and a mechanical analogue of RDT, a rotating barrel transducer, were investigated by an approximate technique. RDT (electronic beam-forming) was represented by a finite series; the solution and representative pressure and frequency waveforms were shown in the Monthly Letter Report for June. RDT was represented by an integral solution; no computations were carried out. Analysis showed that the two transmissions were not equivalent.

(U) However, as a consequence of the results obtained for the mechanical analogue, abandoment of the approximate analysis was recommended and an exact analysis was undertaken. It is expected that the latter analysis plus computations will be completed during July and August, and a technical memorandum summarizing the results will be issued in September.

(U) Early in the last reporting period a study of porpoise transmission and echo-waveforms was proposed. Echoes from targets of known acoustic behavior would be recorded at the animal and telemetered to a recorder for later analysis. A trained Atlantic Bottlenose dolphin, Tursiops truncatus, maintained at the Scripps Institution of Oceanography would be used. A single-sensor receiver-transmitter package to be carried on the dorsal side of the animal was proposed. Design and testing of the circuits was begun late in the reporting period. Initial specifications were for an FM RF transmission at a center frequency of 750 kHz with a 200 kHz receiver bandwidth.

(U) Because of concern over usable RF transmission range the carrier frequency was reduced to 450 kHz and the bandwidth to 150 kHz. By mid-January the receiver-transmitter portion of the package had been breadboarded, and design of the final form of the package begun. An FM receiver to operate at the specified center frequency

with the required bandwidth had been constructed, but performance was not considered satisfactory. A mid-March date was set for testing and recording of echo waveforms at Scripps.

(U) On 7 March, Mr. K. J. Diercks, DRL, Code 2122, visited Scripps to discuss the porpoise training and testing procedures; and the Fleet ASW School (FASWS), San Diego, California, to discuss use of the FASWS closed-circuit video system for recording animal movements while recording echo waveforms. At that time the harness for attaching the telemetering package to the animal had not been completed. Also, the porpoise had not yet been trained to accept the harness, and thus to carry the package. Therefore, the testing date was slipped to late March.

(U) Shortly after this, DRL was informed that the Scripps animal had contacted a general infection and that training and testing would have to be postponed while the animal was being treated. Effort on construction of the telemetering system was reduced; a mid-April date for completion was specified.

(U) Late in April DRL was notified that the animal had recovered and that training was proceeding satisfactorily. An 18 May testing date was established. In early May the telemetering package and receiver were completed and tested. Telemetering was successful, but excessive current drain in the package necessitated some circuit redesign. In mid-May the Scripps' porpoise died. A new animal was acquired in June and handling and training procedures were initiated. No testing date for recording echo waveforms could be specified by the end of June. The telemetering-receiving package is considered operational, and it is anticipated that recording of waveforms will be carried out prior to the end of September.

(U) Because of a lack of personnel, equipment, and a suitable place for conducting the study, the investigation of the ability of listeners to discriminate and/or classify FM echoes from simple geometric targets remained in limbo during most of the reporting period. Audio reproduction equipment was received in March and April, and a listening cubicle was instrumented in May. Several attempts to record acceptable FM up echo waveforms from spheres and cylinders were made during June. Multipath effects and/or recorder noise vitiated most attempts. A tape of 0.6 octave FM up echo forms for five spherical targets was achieved late in June using the DRL Ampex FR-1300 recorder. However, the speed change of the FR-1300 was insufficient for the frequency change required. The number of dubbings necessary to achieve the desired echo parameters so degraded S/N that the recording was discarded.

(U) The PI 6104 recorder was serviced and aligned during June and will be utilized in another attempt to record echoes during July. A self-synchronizing scheme to record echoes from different targets side-by-side on the tape will be used. Echoes will be recorded for five different spheres and cylinders of comparable dimensions: solid, thin-walled air- and water-filled, and thick-walled air- and water-filled. Five time-bandwidth (TW) products will be used: TW = 25, 50, 75, 100, and 125 to determine a minimum bandwidth required for discrimination. Other TW products will be used as required. An attempt will be made to identify shape and/or target specific echo characteristics at all time-bandwidth products.

(U) Results of listener recognition performance will be reported in the Monthly Letter Reports for July and August.

(U) Design and construction of a proto-type (without transducer) high-speed mechanical scanner for simulating Rotating Directed Transmission (RDT) was begun in June; drawings were completed and

UNCLASSIFIED

components ordered. The device will be completed in late August or September and installed on the Echo Studies barge at the LTTS. Vibrations and noise tests will be conducted and if suitably low values are obtained, transducers and housings which scale the AN/SQS-23 transmission parameters to the models of the USS PERMIT and the USS SKIPJACK will be constructed. Similar noise and vibration tests will be required for the operational model.

12 October 1967

(This page UNCLASSIFIED)

DISTRIBUTION LIST FOR BIANNUAL PROGRESS REPORT NO. 5
for
CONTRACT NObsr-93124
(CONFIDENTIAL GROUP 4)

Copy No.	
1 - 4	Commander, Naval Ship Systems Command Department of the Navy Washington, D. C. 20360
5	Commander, Naval Ship Systems Command Department of the Navy Washington, D. C. 20360 Attn: Code 1623, Mr. J. P. Jenkins
6	Office of Naval Research Resident Representative The University of Texas at Austin 2507 Main Building Austin, Texas 78712
7	Acoustics Division, DRL/UT
8	Psychophysics, DRL/UT
9	Signal Physics Branch, DRL/UT
10	K. J. Diercks, DRL/UT
11	R. K. Goodnow, DRL/UT
12	K. W. Harvel, DRL/UT
13	Library, DRL/UT